Overview of the measurements at Whistler Peak during Intex-B

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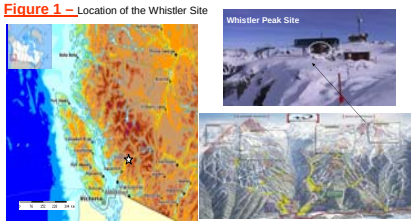
INTRODUCTION

- The Canadian contribution to the INTEX-B campaign included mountaintop measurements, aircraft vertical profiles, ground-based aerosol Lidar measurements and modelling for April 20 – May 18, 2006. The study was conducted in the region of Whistler, British Columbia and was anchored by measurements at the peak of Whistler mountain.
- Environment Canada began measurements at this high elevation site on the west coast of Canada in March 2002 to measure particles and selected trace gases to address the issues of trans-Pacific transport of pollution. This site is located on the summit of Whistler mountain (2182 m-asl), approximately 100 km north of Vancouver.
- During the spring 2006 campaign, the regular suite of trace gas and particle measurements at the Peak site was augmented to include a wTOF-AMS, a Tekran (Hg), and multi-stage impactor samples.

Figure 1 – Location of the Whistler Site



Instrumentation

Trace Gases:

- O_3 (TECO 49C), CO (TECO 48C), Hg (Tekran)

Particle Chemistry:

- 24 or 48 h filter packs analyzed by IC and atomic absorption spectroscopy for water soluble inorganics ($SO_4^{=}$, NO_3^-, NH_4^+, Ca^{2+}, Cl^-, Mg^{2+})
- Moudi impactor samples (3-stages)
- WTOF-AMS, 12 hour filter packs (OC/EC)

Particle Physics:

TSI Scanning Mobility Particle Sizer (10 nm to 200 nm)

Grimm Optical Particle Counter (300 nm to 20 µm)

Particle Light Scattering and Absorption:

Nephelometer, PSAP

Meteorology: Temp, Press, RH, Wind Speed and Direction

Indicates additions during the INTEX intensive

RESULTS AND DISCUSSION

Meteorological Influences

- Whistler Peak encounters air masses from both the free troposphere and the boundary layer thus the chemistry is influenced by local (Whistler valley), regional (e.g. Vancouver/Seattle) and long-range (e.g. trans-Pacific) transport events.
- The peak site is primarily in the free troposphere at night but mixed layer influences are common during the daytime, particularly during the warm spring and summer months.
- Temperature data from every 300 m up the mountain side are employed to calculate stability parameters and estimate the mixing height around the Whistler site. Figure 2 shows a time series of the measured Peak temperature, and also temperatures calculated from a lower altitude temperature and the dry and wet adiabatic lapse rates. Based on these estimates, the transition from the free troposphere to the boundary layer is generally expected between 9-10 am with the transition back to free tropospheric air by 7 pm.
- This is reinforced by aircraft profiles (Figure 3) from the mornings of April 23, and 25 when the Peak site is in the free-troposphere, and from the late afternoon of May 2 when the boundary layer has mixed to approximately 3 km altitude – above the station altitude of 2182 m.

Figure 2

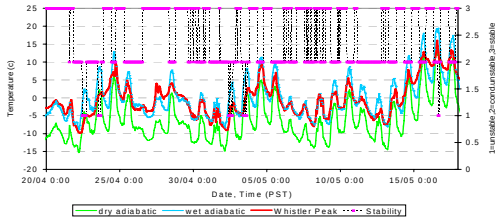
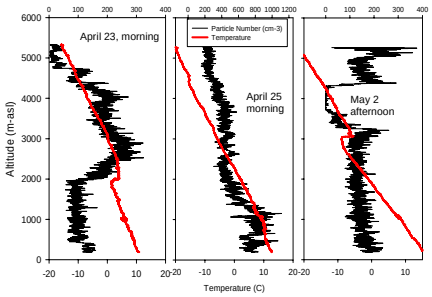


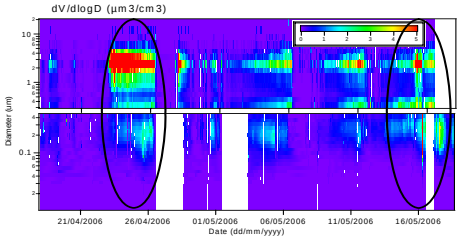
Figure 3



Particle Measurements

Particle distributions from both the Grimm OPC and the TSI DMA are shown as volume distributions in Figure 4 for the April 18-May 18 period. Two periods of interest are identified: April 23-25 which is characterized by the dominant coarse mode aerosol; and May 14-16 which again has a coarse mode component but also has significant mass in the accumulation mode.

Figure 4 Particle distributions – 10 nm to 20 microns



Corresponding particle chemistry measurements from the 3-stage impactors are shown in Figures 5 and 6 for Calcium and Sulphate respectively. The high calcium concentrations April 23-25 are consistent with the higher coarse mode mass and a transport of dust to the site. Highest sulphate concentrations were encountered during the May 15-16 event when the higher accumulation mode mass was observed.

Figure 5

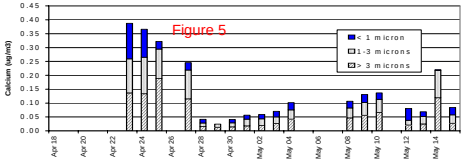


Figure 6

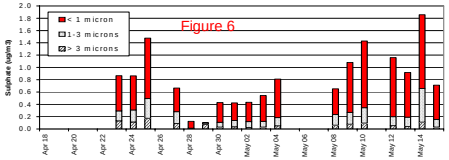
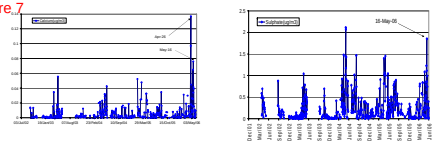
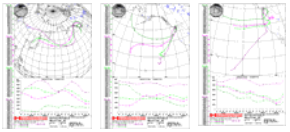


Figure 7



The magnitude of this dust event is seen in Figure 7 which shows that the calcium concentrations during these spring 2006 events are the highest measured from filter packs at the Peak site from 2002-2006.



Back trajectories (Figure 8) calculated from the Canadian Meteorological Centre's model show the trans-Pacific transport for the April 23-25 event and flow off the Pacific initially during May15-16 followed by regional transport.

Trace Gas Measurements

Figure 9

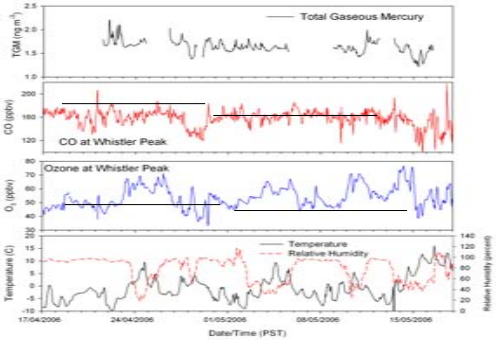


Figure 9 shows trace gas, temperature and relative humidity measurements. Total gaseous mercury 1.25 to 1.75 ng m^{-3} although some increases of up to 2 ng m^{-3} were observed. Ozone varied between 40 and 70 ppbv with higher values during the periods of subsidence. Four-year mean values of ozone and CO for April and May are superimposed on the plots.

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